FOREST Management BULLETIN

GROWING AND PLANTING CONTAINERIZED SEEDLINGS

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BACKGROUND

In 1961, John Walters of British Columbia reported on the "Planting Gun and Bullet", a new tree planting technique involving the use of containerized seedlings.

At the time, containerized seedlings were being used extensively in many other countries but to only a limited extent in North America. Since that time a great many forestry research organizations, both private and public, in the U. S. and Canada have experimented with growing and outplanting seedlings in containers.

On September 8 and 9, under the auspices of the Southeastern Area, State and Private Forestry, some 40 researchers and forest managers from Canada and many parts of the U. S. met in Alexandria, Louisiana, to relate their successes and failures with containerized seedlings and to discuss the problems they had encountered. This bulletin sums up the information presented.

OBJECTIVES

Development of containerized planting stock is pursued for many reasons. These include:

- Improve survival and growth of selected species such as longleaf pine, black walnut, oak and eucalyptus.
- Provide a type of planting stock adapted to tough or adverse sites.
- Extend the planting season to allow for better utilization of scarce labor and for planting at the most suitable time for seedling survival, i.e., when wet sites are dry enough for equipment.
- Shorten the time needed for seedling production, thus allowing for early replants of failed plantations or stands destroyed by wildlife, hurricanes, and other disasters.
- Facilitate adjusting nursery production schedules to meet fluctuating demand for seedlings with smaller capital investments.
- Help meet the need for automation and mechanization in both nursery and field operations.

Examples of Containers. More than 30 different seedling containers have been tried by foresters in the U. S. and Canada.

SPECIES TRIED

Species outplanted in containers on this continent so far include:

Pine

Jack
Loblolly
Lodgepole
Longleaf
Ponderosa
Sand
Scotch
Shortleaf
Slash
Virginia
Western White
White

Fir

Fraser
Grand
Noble

Douglas-fir

Spruce

Black
Blue
Norway
Sitka
White

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Oak	*Other Hardwood*
Black	Black walnut
Cherrybark	Black cherry
Northern red	Eucalyptus
Scarlet	Mahogany
Shumard	Polonia
White	Red alder
	Sweetgum
	Sycamore
	White ash
	White birch
	Yellow-poplar

CONTAINERS TESTED

Blocks	*Pots*
Peat	Japanese paper
Styro	Peat
Oasis foam	Fertile
BR-8 wood pulp	Peat pellets
Polyurethane nutrient foam	Tar paper
	Mud and cow manure

Tubes	*Other*
Kraft paper	Banana leaves
Polypropylene mesh	Palm leaves
Plastic bullets	Newspaper
Split styrene	Polyethylene bags
Sausage casing	Bamboo
Polyethylene sleeve	Lacquered tin
Styrene	RCT containers
Perforated paper	Organic plugs
Wood veneer	Plastic honeycomb
Folded metal	Extruded soil

THE CONTAINER

All are concerned about the effect of the container on root development. Composition, size, and shape of the container appear to be major factors in root development and subsequent escape from the container. In some of the heavy containers the roots become bound, fail to emerge and enter the soil, or if they do emerge develop only in one plane. Some containers have girdled the seedlings at the groundline. These deficiencies have resulted in mortality, slow growth, and lack of windfirmness. In some cases where seedlings were kept in pots too long before planting, the resultant trees 10 years later could be pushed over or pulled out of the ground by hand. (Ed. note: Improperly planted barerooted stock can exhibit these same weaknesses).

Cases were reported of round containers causing the roots to spiral, eventually resulting in the girdling and death of one or more of the roots and, in subsequent years, even death of the tree through girdling. In some cases, the roots tended to develop between the layers of Kraft paper tubes. Some felt that the chlorotic color of seedlings grown in these tubes may have been the result of the toxicity of the boron in the paper. Others reported what appeared to be nitrogen deficiencies. Irrespective of the composition of the containers, most of the roots grow downward with little lateral root development. Square or hexagonal containers are considered to be better than round ones. Where the media was the container, as with the BR-8 or Jiffy Pellet, lateral root development appeared unrestricted.

The lack of prompt disintegration of the container in the field can be solved in two ways — by using biodegradable materials or by planting containerless seedlings grown in media such as the BR-8 blocks, polyurethane blocks, and peat pellets. Where actual containers are used, it is also possible to remove the seedlings from the container before planting by lifting the seedlings out of the styro block or by removing the container at the time of planting (a special planting tool, for example, slits the sausage casing on four sides as the seedling is inserted into the ground).

Containers can play a very important role in hardwood establishment, particularly that of high value hardwoods such as black cherry and black walnut. They have a place in special situations such as shelterbelts where a relatively slow growing but hardy tree is needed and cost is a secondary consideration. Containers also are useful for genetics work, such as progeny testing. They have been operationally successful in some parts of Canada, both because nursery production time has been greatly reduced and because field survival has been satisfactory — 60 percent or better.

GROWING MEDIA

Materials used in the containers as the growing media include sand, vermiculite, peat, perlite, topsoil, and sphagnum moss, singly or in varioux mixtures. Opinions vary as to whether nutrients should even be added to the media and, if they are needed, when and in what amounts they should be applied. Too early an application in the nursery or greenhouse has caused damping off. Many of the participants felt that the nutrients should be added through the watering system and that subsurface irrigation (irrigation from the bottom) was preferable. Several suggested that Hyponex (with an NPK ratio of 7-16-19) was the best fertilizer they had found.

The growing media used in the container should have all of the desirable properties of the soil and none of the undesirable properties. The media should vary with the species. Pure peat, for example, is not satisfactory for some hardwoods. It may also be necessary to vary the media with the type of container used. Some feel that inert ingredients are best for seedling growth.

PRODUCTION AND OUTPLANTING

Lack of knowledge of the physiological requirements of each species has created problems in growing these seedlings both in the greenhouse and under outdoor conditions. For example, each species has an optimum day and night temperature, length of day, and carbon dioxide level for best growth. To attain these, greenhouses may become prohibitively expensive. Damping off and the development of mosses and liverworts are fostered by the high humidities in the greenhouse, although similar conditions can occur with containerized seedlings grown under outdoor conditions. When manufactured media such as perlite are used alone, natural inoculation of mycorrhiza may be lacking. A limited controlled environment – air conditioning in some cases – may be needed for germination of some species. For some species and treatments, it is very important to allow the seedling to become acclimatized before planting, particularly those grown in greenhouses.

Once in the field the seedlings, which may be as young as six weeks, are susceptible to damage from a great variety of forest pests. Containers have been scratched from the ground by birds or animals. Mole crickets and birds have clipped off young seedlings. Webworm and other insects have killed seedlings. Disease, including *Fomes annosus,* has also been a problem. Some frost heaving of containerized stock has been reported on spoil banks and on heavy clay soils. Canadian experience indicates the top of the container must be below the surface to prevent frost heave.

Outplanting containerized seedlings does not guarantee resistance to summer drouth. The peat pots, for example, frequently dry out at a faster rate than the surrounding soil and pull away from the sides of the planting hole. Roots may be slow to penetrate the soil and, if the seedling lives, it may not grow much the first year. Reports from the field are conflicting and vary with the species, and type and size of containers. In the South, the majority have found that containerized seedlings do not grow as fast as barerooted stock during the first several years and may never catch up. Experiences in the North indicate containerized seedlings may have survival rates and growth as good as or better than barerooted stock.

Higher caliber labor is required not only in the nursery but in the outplanting operation as well. This type of labor is frequently in short supply. If management's hope that the use of containerized seedlings will enable the year-round employment of a permanent crew of forest workers is realized, we may attract and hold better quality labor.

The Finnish and several Canadian organizations have systematized the production and outplanting operation to a high degree, but most foresters in the South are concerned with the logistics. In one large-scale field trial, tubes that weighed approximately one-third of a pound each were hauled from the nursery to distant field locations in the summer in refrigerated trucks. With the tubelings packed in boxes weighing 70 pounds each, it was difficult to keep the planting machines or hand planters supplied. Several organizations have developed special carrying racks for seedlings grown in plastic bullet-shaped containers. These weigh far less than some of the cardboard containers.

Containerized seedlings have been field planted in holes punched or drilled in the ground, in slits made with the standard planting bar, or in trenches furrowed out by a planting machine. As is the case in planting barerooted stock in certain soils, the planting tool has compacted the soil to such an extent that the roots cannot escape from the hole or the slit. Early slow growth or mortality may be due to this as well as to poor root development resulting from restriction by the container.

COSTS

The container, the growing media and nurturing of the seedlings in the containers, whether in the greenhouse or nursery, is costly. Costs of $60.00 per thousand and more were cited. On the other hand, some types of containerized seedlings cost less to hand plant than barerooted stock – down to one fourth as much. Machine planting rates for containerized seedlings using standard planting machines are similar to those for ordinary nursery seedlings. However, work is underway on the development of planting machines especially designed for uniform planting stock, thus requiring less horsepower and manpower to operate.

At the present time the only ones reporting monetary savings through the use of containerized seedlings are those that formerly planted 2-0, 2-1, 2-2, or 3-0 barerooted stock. Through the use of greenhouses they have shortened the time required to produce a plantable seedling to one year.

In the South at the present time, 1-0 barerooted seedlings cost less to produce, handle and ship than do containerized seedlings. The principal interest is not in replacing the barerooted seedling but providing a supplement to meet particular needs and situations. In areas where two- and three-year-old seedlings and/or transplants are required or where survival and growth of some species is a problem, containerized seedlings can be economically and silviculturally very important even today. As research progresses, methods of decreasing container handling costs at the nursery and in the field through mechanization could make containerized seedlings an attractive alternative to barerooted stock.

POINTS TO CONSIDER

Anyone considering the utilization of containerized stock for an extended planting season should first consider how long an extension is needed. The use of refrigerated barerooted stock can extend the planting season six weeks. It does little good to extend the planting season into months when the weather and soil moisture conditions are unfavorable for good survival and growth.

Determining the stage at which containerized seedlings should be outplanted with respect to site, potting medium, and pot sizes seems to be a point where some of the wrinkles need to be ironed out. The size of the container has to be matched to the size of the tree to be grown. Species have varying root generating potential, but generally root development in the container is rapid. Roots should be pruned off rather than torn off in outplanting. Abrading the surface of the root system will stimulate new lateral root development and may even destroy roots that will otherwise girdle the tree. Air and water pruning are used successfully in some systems.

The quality of all materials used must be upgraded. The seed must be of the highest quality. Any paper used to make the tubes should be standardized as to its chemical ingredients.

The majority of researchers believe that priority should be given to the questions of optimum container configuration and composition of material. Species requirements for growth of the desired types of seedling must be established. Next we must determine what happens in the field when these containerized seedlings are outplanted. Then and only then should we become concerned with cost considerations. Container manufacturers stand ready to help if we can give them a volume market.

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